mendation of the International Commission. But the congress itself has decreed that "no proposition for change in the code is permitted to come before the congress unless it is presented to the Permanent Commission at least one year before the meeting of the congress."

A letter from Dr. Stiles, the secretary of the commission, informs me that the congress has gone on record to the effect that it demands "a unanimous vote of the commission before any matter will be considered by the congress."

It is interesting to speculate at this point whether there is any conceivable method by which a dignified body of scientists could more completely and finally tie its own hands than the one here solemnly consummated by the International Congress of Zoologists. The method, in brief, is as follows:

1. Appoint a commission with power to formulate a code.
2. Formally adopt that code.
3. Forbid any amendment to be introduced except through the commission.
4. Declare that nothing will be considered unless brought before the congress with the unanimous vote of the commission.

I submit, most respectfully, that nothing more perfect of its kind has every been perpetrated by any political machine or autocrat.

All that the commission has to do is to "stand pat." The congress has done the rest.

C. C. NUTTING

HENRY JAMES CLARK: TEACHER AND INVESTIGATOR[1]

HENRY JAMES CLARK, or H. James-Clark as he often wrote his name, sometimes called, not inaptly, the first professor of natural history at this college, was the first trained zoologist to occupy a chair here. But hardly had he entered upon its duties when he was called from this life in the flower of his age.

Born at Easton, Massachusetts, on the twenty-second of June, 1826, the son of a clergyman, his father moved to Brooklyn, N. Y., where he lived many years and where the son received much of his early training and was fitted for college. After completing his preparatory studies, he entered the University of the City of New York, and was graduated thence in 1848. From college he went as a teacher to White Plains, and while engaged in the study of botany, made observations upon the structure of *Chimaphila* and *Mimulus,* which he communicated to Dr. Gray. These and subsequent observations upon the flora of the neighborhood attracted to him the favorable notice of the latter, who invited him to Cambridge. Thither he went in 1850, and enjoyed for a time the advantages of a pupil and private assistant at the botanic garden. While a student there he taught, for a single term, the academy at Westfield, achieving much success as a teacher. Soon after this a taste for zoological studies, developed by the lectures of Professor Agassiz and frequent visits to the zoological laboratory, led him to abandon botany for what appeared the more fascinating study of animal life. Graduating from the Lawrence Scientific School in 1854, he became immediately after the private assistant of Professor Agassiz. Three years later Agassiz spoke of him enthusiastically, remarking to a friend, "Clark has become the most accurate observer in the country." In June, 1860, he was appointed assistant professor of zoology in the Scientific School at Harvard University, a position he held until the expiration of his term of office.

A few weeks following his appointment he went abroad, mainly for his health, traveling in England, France, Germany and Switzerland, often on foot, and visiting the leading universities and museums. He met many scientific workers, including Allman, Alexander Braun, Gegenbaur, Haeckel, Huxley, Leuckart, von Martius, Milne-Edwards, Schleiden, but especially Owen, whose guest

[1] An address delivered at the dedication of the building for entomology and zoology at the Massachusetts Agricultural College, November 11, 1910. In the preparation of this sketch I am indebted to Dr. Edward S. Morse and Professor A. E. Verrill for much valuable information.

he was at Sheen Lodge, Richmond Park. While in Germany he attended the meeting of German Naturalists and Physicians at Königsberg, of which he has left an interesting account in his notes of European travel.

In the spring and summer of 1861 he gave a course of lectures on histology at the Museum of Comparative Zoology. One of his friends writes:

> I remember his interesting lectures before our small class on cellular structure in plants and animals. His skill with the microscope and his rare ability to draw aided him greatly in making out the minutest details of cell structure. His personal qualities were of a kind to endear him to many friends, especially to those students who sought and obtained from him counsel and advice in their studies, as I did on many occasions.

The small class included Hyatt, Morse, Packard, Putnam, Scudder, Shaler and Verrill.

Notwithstanding his constant investigations, Professor Clark found time to prepare a course of twelve lectures—the result of his microphysiological studies—which he delivered at the Lowell Institute in the winter of 1864. These were subsequently rewritten and published in 1865, under the title of "Mind in Nature; or the Origin of Life, and the Mode of Development of Animals." This work, based on structure and development in the animal kingdom, is crowded with original observations and testifies to years of the severest labor and independent thought. "It is in all respects," says Packard in 1873, "for its usually sound and clear thinking, its breadth of view and the amount of original work it contains, perhaps the most remarkable general zoological work as yet produced in this country."

Clark adopted and strongly urged the doctrine of spontaneous generation, from the facts afforded by the experiments of Jeffries Wyman, and on the question of evolution adopted views resembling those of Richard Owen. The original matter in the book is that relating to the structure of *Bacterium termo* and *Vibrio bacillus,* the theory of the egg and its polarity and bilaterality, and the cellular structure of *Actinophrys,* with many other new points relating to the anatomy and physiology of the Protozoa and Radiates. It anticipated also certain points in histology, and the structure of the Protozoa and Sponges especially, which have made the succeeding labors of some European observers notable.

In 1866 Professor Clark accepted the chair of botany, zoology and geology at the Agricultural College of Pennsylvania, where he remained three years, exchanging it in 1869 for similar duties at the University of Kentucky. Neither of these posts was agreeable to his taste, chiefly on account of the pressure of college duties, which left him but little time for abstract investigations. It was, therefore, with great readiness he accepted the call to this college in 1872.

Here his duties were of a more congenial nature, and he applied himself with renewed energy to teaching and soon began the formation of a museum—a working collection of comparative and pathological anatomy. Turning to his first and only report—remarkable for its clearness, particularity and insight—we find that he taught human anatomy and physiology, comparative anatomy and zoology, and comparative physiology. These studies were to form the groundwork for a course in general and veterinary pathology. He lays stress on the importance of the objective method of teaching in the class-room and of laboratory instruction. "Having mastered," he says, "the general principles of structure and relation throughout the length and breadth of the animal kingdom, the rawness of total ignorance is supplanted by a new habit of thought, and a proneness to make further inquiry upon meeting with any object in nature. Here, then, comes the time for laboratory practise. Supplied with scalpel and magnifier, the student should be required to work out topics upon unprepared specimens. If he has acquired the smallest grain of interest in the matter previously, patience will enter where it could not possibly have existed before. He learns the art of seeing and knowing what he looks at; he becomes by degrees an observer; and in doing that, he is

also becoming unconsciously a draughtsman, and when required, as he should be, to produce with pencil what he sees, if he wants to do it, he will do it instinctively." Lastly, Clark had in view graduate courses for advanced work and for special training.

His work was now interrupted by a severe illness. Never robust, his assiduous and confining labors had seriously impaired his health. As early as 1857 are entries in his diary of symptoms indicating that the seeds of the disease that was to cut him off in his prime were then sown. After much suffering, on the first of July, 1873, at the age of forty-seven, his useful life came to an end. He was a member of the leading scientific societies in this country, including the National Academy of Sciences, which up to that time was limited in membership to fifty of the foremost scientists of the country.

His first love for science, writes one who knew him well, seems to have grown from his fondness for flowers. After he became a student of Professor Agassiz his love for botany remained undiminished. He studied it in after years from the side of vegetable histology and morphology in connection with and as illustrating the histology and morphology of animals. The influence of his knowledge of botany on his zoological studies was marked. It prepared him for his studies on spontaneous generation, on the theory of the cell, on the structure of the Protozoa and the nature of protoplasm. In studying the lassocells of the acalephs, he traced their analogical resemblance to the stinging hairs of the nettle. By his intimate knowledge of the spores of the smaller algæ he was able to point out some of the characters separating the lowest Protozoa from the spores of plants, and aid in the work of Thuret and others in eliminating from the animal kingdom certain vegetable spores which had been originally described as Infusoria.

In his first scientific paper, communicated by Dr. Gray in 1856, he showed that in most of our North American gentians the ovules are spread over the whole parietes of the ovary, either irregularly or in vertical lines on the veins. His next paper was on the peculiar growth of rings in the trunk of *Rhus toxicodendron,* and this was supplemented by further studies on the eccentricity of the pith of *Ampelopsis quinquefolia* and *Celastrus scandens.* He made experiments for a series of years on the value of the bark to the life of the tree. He observed the relation and development of the filaments which connect the anthers to the sepals of *Comandra umbellata.* In his paper on the identity of the vibrios and the muscular fibrillæ, he showed how the latter during decomposition break up transversely, the fragments assuming the form and movements of the former. He also made observations on the absorption of albumen in the cells of plants. His last purely botanical paper (1859) was on the nature of the glandular dots of the pine. His skill in the use of the fine lenses made by Spencer (under his direction) enabled him to see more than his predecessors of the true relations of these dots. But his botanical studies did not end here, as may be seen by reference to his diaries and his frequent allusions to the lower algæ and to vegetable histology in "Mind in Nature." In his walks he often botanized, and contributed in this way to Gray's botanical textbooks. Thus with the training he received from Gray and Agassiz, he looked upon the world of organized beings from both the botanical and zoological side. He well deserves the name, *biologist.*

Between 1856 and 1863 he was associated with Agassiz in the preparation of the anatomical and embryological portions of the great work entitled "Contributions to the Natural History of the United States." To these volumes he was a large contributor, most of the histological and embryological portions of the work being his, and more than half the plates illustrating the embryology and histology of the turtles and acalephs bear his name. "In the preparation of this part of my work," says Professor Agassiz, "I have received much valuable assistance from my friend and colleague Professor H. J. Clark, who has traced with me, for more than nine years, the metamorphoses of our Acalephs,

and especially those of the Hydroids. He discovered the peculiar structure of the lasso-cells of the Ctenophoræ."

During this time Clark began the serious study of the Protozoa, undoubtedly compelled to do so in order to properly interpret the histological facts then accumulating in the study of the Radiates. After leaving Cambridge he studied the Infusoria and lower plants, and made drawings and notes comprising descriptions of many new forms of Infusoria. He planned an extensive work upon this subject, which, had he lived to complete it, might have equalled if not surpassed Claparède and Lachmann's famous work on the Infusoria. He did not dissociate the Protophyta from the Protozoa, regarding them as almost inseparable in nature; thus, in his lectures to his classes, well nigh anticipating Haeckel's classification of the lowest forms of the animal and vegetable kingdom into the Protista and Protozoa.

In his first paper on *Actinophrys* (1863) he announced the discovery that "all vibratile cilia originate in the amorphous intercellular substance," and do not form direct prolongations of cells, *i. e.*, that cilia are prolongations or extensions of the protoplasmic substance of the cells from which they arise. The same year he discovered the eggs of *Tubularia,* and showed that there was but one type of development in the Hydromedusæ (excepting the Narcomedusæ and Trachymedusæ), and that the differences observed in the developmental process were merely modifications of degree and not of kind, an exceedingly valuable addition to our knowledge of the affinities of the various groups of Hydromedusæ.

Foremost, perhaps, among his several discoveries with the microscope was that of the true nature of the cilio-flagellate infusorians and the sponges. In 1866 appeared a brief paper, entitled "Conclusive Proofs of the Animality of the Ciliate Sponges, and of their Affinities with the Infusoria Flagellata." While Clark had endeavored to show in his Lowell Lectures that there was a unity of plan in the organization of the Protozoa, their bodies being arranged in the form of a helix, he now endeavored to prove that the sponge did not depart from the protozoan type. In the full memoir, published about a year later, under the title "Spongiæ Ciliatæ as Infusoria Flagellata," he attempted to establish the homology of the flagellate cells of the sponge with the flagellate Infusoria. His discovery of the flagellated cells of living sponges and demonstration of their animal nature was a great step in advance of previous observers. While, as Clark observes, Carter had first detected the true criterion of their animality, this was confirmed and demonstrated still more completely by Clark himself, as acknowledged by Carter in his "Confirmation of Professor James-Clark's Discovery of the True Form of the Sponge-cell (Animal)."

The Choanoflagellata, or collar-bearing flagellate animalcules, were discovered by Clark, and his further discovery that the flagellated (ciliated) chambers of sponges are lined by collared cells of the same peculiar structure as the individual Choanoflagellata, led him to regard the sponges as colonies of Choanoflagellata. The views maintained by Clark with reference to the position and affinities of the sponges were, that these organisms must be regarded as compound colonial forms of Flagellata, whose units, in the case of *Leucosolenia,* exhibited a type of structure essentially similar to that of *Codosiga* and *Salpingœca*—genera established by him to receive his collared cell forms—but might possibly in other instances more closely approximate to that of *Monas* (*Spumella*) *Bicosœca* or *Anthophysa.* In these views he was supported by the observations of Saville Kent and Stein, and in the main by those of Carter and to a less extent by Balfour, but opposed by Haeckel and F. E. Schulze. The subsequent discovery by Saville Kent of *Proterospongia* (*Savillia*) at that time rendered the derivation of the sponges from the Flagellata at least a tenable hypothesis, while Balfour considered them as an intermediate group between the Protozoa and Metazoa.

In the last paper he published Clark compared the arguments adduced by Haeckel in

favor of the cœlenterate affinities of the sponges with the actual structural composition of *Spongilla* and *Leucosolenia,* and reached the conclusion that the relationship of the sponges to certain flagellate Protozoa was so distinct and decisive as to forbid their logical inclusion among the representatives of any other class. The universal and characteristic collared cells of sponges point emphatically to a choanoflagellate ancestry and, as a recent authority has observed, in the present state of our knowledge it would be difficult to frame a definition of the Protozoa which should absolutely exclude the sponges. His work on flagellate Protozoa and sponges was a valuable contribution to science. Since his time great advance has been made in our knowledge of the histological structure, mode of reproduction and embryological development of these organisms, due mainly to the opportunities offered by novel and refined methods of technique. Had the art of making thin sections and the staining of tissues been known in his day, he would certainly have anticipated much of the later work of cytologists and embryologists.

In the use of the microscope, Clark showed not only mechanical skill and ingenuity, but a patience, caution, and experience in difficult points in histology, which undoubtedly placed him at the head of observers in this country and rendered him perhaps inferior to few in Europe. He used the highest powers with a skill that few if any living observers have surpassed. He suggested improvements carried out by Spencer and Tolles in this instrument. In 1857 Professor Agassiz sent him to Canastota to confer with Spencer, and as a result a microscope was made by him which was fully equal to any made at that time in Europe. Clark suggested that we must have three kinds of objectives: one with the field extremely flat; another, an immersion lens—the first made, so far as we are aware, and now so universally used; and a "third with a depthing focus extending as far as possible beyond that of the ordinary kind, for the purpose of viewing objects as a whole, in order to ascertain the relations of their different parts." This microscope was in use in 1859.

In 1878, five years after the death of Professor Clark, the Smithsonian Institution published, as one of its Contributions to Knowledge, his monograph of the "Lucernariæ and their Allies." This group was the subject of his last studies, though one which had early engaged his attention. Complete and elaborate as it is so far as it extends, this beautiful memoir is only a fragment of what was evidently designed to cover at least fifteen parts, two parts only having an actual existence. It has been well said that a broken shaft would represent both the author's life and this posthumous work, each symmetrical and thoroughly finished to the point where they suddenly broke off.

The Lucernarians were not regarded by Clark as truly radiate animals, but in a degree bilateral, with a fore and hinder end. The commonly received theory at that time that the so-called Radiata are founded upon the idea of radiation, was combated by him in 1865. The views of the present day coincide in the main with his—that radiation is, on the whole, a superficial feature, not always constant in Cuvier's Radiata, though often well marked. He regarded the so-called polymorphic individuals as "organs under various disguises," and he ascribed a high degree of individuality to the jelly-fish, *Pelagia,* and only a less amount to *Lucernaria.* He believed with the advanced histologists of his day that "*cells* so-called (no matter whether constituted according to the older histologists or according to the most recent theory) are, after all, of secondary importance, and that the *cytoblastema* or protoplasm (which we do not distinguish from inter-cellular substance) is in the main an *essential element,* the potential progenitor of all tissues, and that it projects itself into the utmost feature of the living body by a process of self-proliferation. Through this, and this only, can a true *law of continuous development* be illustrated; while the various forms of cell-tissue, and fiber-tissue, and bone-tissue, etc., are but the disjointed collateral developments,

each one irrespective of the other, from the continuous, onward stream of cytoblastema." He says, further, that "all Rhizopods are moving, sentient masses of *Cytoblastema,* and that alone."

Clark was admirably adapted by nature for doing histological work of the highest order. He possessed that philosophic insight of the true naturalist which often enables him to *divine* much further than he can perceive in the tracing of relationships and to anticipate what the microscope is to reveal. At the time he began his work as an observer, zoological science in America was especially deficient in histological investigations, and he did more than any one else to remove this reproach upon American biology.

"Henry James Clark," said Asa Gray at the time of his death, "deserves to be enrolled in the list of botanists. Although his high reputation was won in another department, he was an excellent botanist before he became Mr. Agassiz's assistant and gave himself to zoological investigation: the present writer was indebted to him for more than one interesting discovery of points of structure. He is thought to have been the ablest microscopic investigator which this country has produced." "His labors as a zoologist," said James D. Dana, "especially in those departments requiring difficult microscopic research, had placed him among the two or three first in the country, and given him a world-wide reputation. He was always working, and full of enthusiasm in science, and also a most genial and excellent man."

In the preface to volume one of the "Contributions to the Natural History of the United States," dated October 3, 1857, Professor Agassiz says:

> Mr. H. James Clark has assisted me from the beginning of my investigation of the embryology of these animals, and drawn, with untiring patience and unsurpassed accuracy, most of the microscopic illustrations which adorn my work. I owe it to Mr. Clark to say, that he has identified himself so thoroughly with my studies since he took his degree in the Lawrence Scientific School, that it would be difficult for me to say when I ceased to guide him in his work. But this I know very well, that he is now a most trustworthy observer, fully capable of tracing for himself the minutest microscopic investigation, and the accuracy of his illustrations challenges comparison.

In a lecture given at the summer school of Natural History at the Island of Penikese, early in July, 1873, Professor Agassiz announced the death of Professor Clark and spoke in the highest terms of his work and of him as a man. He said that as a microscopist and histologist he regarded him as fully equal if not superior to Ehrenberg, who was at that time considered the best in the world.

Professor Fernald, to whom we owe the department of entomology in this college and in whose honor we are gathered to-day, has expressed the opinion that he was the most brilliant of all the young men that Agassiz drew round him when he first came to this country; that as an artist in illustrating his work he probably had few if any equals, and as an observer and investigator he must be placed in the front rank of the naturalists of his time. In marine zoology he probably had no superior, and if his life had been spared he would undoubtedly have left a marked impress on the college.

Three things can be said of Clark. He was a genius, he had the best of teachers, and he made the most of his opportunities. The secret of his success as an investigator may be stated in his own words taken from his diary, where he says, "I made it a rule to practise the utmost rigidity and thoroughness in my researches, without regard to time consumed or the value of the results." Such was the life of Henry James Clark, full of supreme devotion to science and showing an indomitable energy in the search for truth.[2]

FREDERICK TUCKERMAN

[2] Several species bear his name. Agassiz dedicated to him the acaleph, *Idyiopsis clarkii;* Bütschli the animalcule, *Salpingœca clarkii*—a name later bestowed by Stein upon another form of the same genus. His services are also commemorated in *Ascortis clarkii* of Verrill, the most delicate species of calcareous sponge found on our coast.